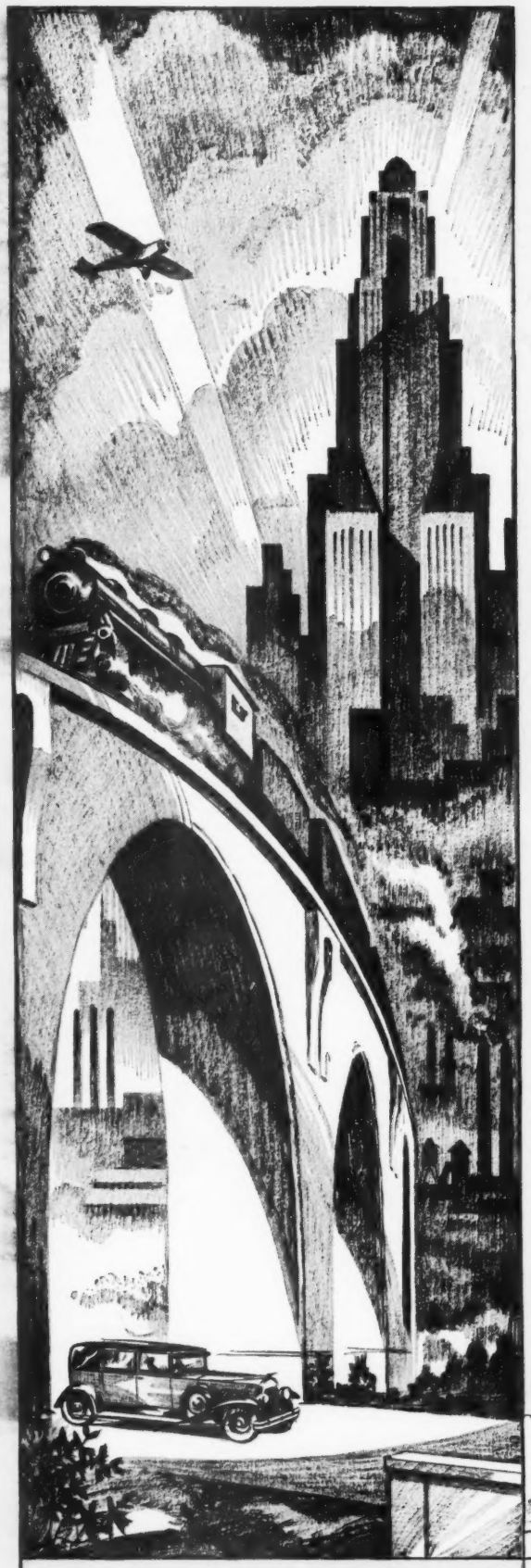

The CRUSHED STONE JOURNAL

In This Issue

January • 1932

Official Publication
NATIONAL CRUSHED STONE ASSOCIATION

Twenty-Five Cents Per Copy

WHY HAVE LOSSES

Poor Grading—High Overhead—Troubles

Ask the following stone producers why they are using NIAGARA ROLLER BEARING SCREENS year after year

Solvay Process Company	Jamesville, N. Y.
Solvay Process Company	Syracuse, N. Y.
Rock-Cut Stone Company	Auburn, N. Y.
Rock-Cut Stone Company	Ballina, Madison Co., N. Y.
Rock-Cut Stone Company	Jamesville, N. Y.
Rock-Cut Stone Company	Laconn, N. Y.
Rock-Cut Stone Company	Watertown, N. Y.
Mohawk Limestone Products Company	Mohawk, N. Y.
Mohawk Limestone Products Company	Jordanville, N. Y.
Mohawk Limestone Products Company	Mount Vision, N. Y.
BUFFALO Crushed Stone Company	Buffalo, N. Y.
Federal Crushed Stone Company	Cheektowaga, N. Y.
Genesee Stone Products Company	Stafford, N. Y.
LeRoy Lime and Crushed Stone Company	LeRoy, N. Y.
Ribstone Concrete Products	LeRoy, N. Y.
Dolomite Products Company	Rochester, N. Y.
General Crushed Stone Company	Oaks Corners, N. Y.
General Crushed Stone Company	North LeRoy, N. Y.
General Crushed Stone Company	Glenmills, Penna.
Wagner Quarries	Sandusky, Ohio
Wagner Quarries	Castalia, Ohio
Dolomite, Inc.	Maple Grove, Ohio
Herzog and Sons	Forest, Ohio
Ohio Blue Limestone	Marion, Ohio
National Lime & Stone Co.	Spore, Ohio
National Lime & Stone Co.	Carey, Ohio
National Lime & Stone Co.	Lewisburg, Ohio
National Lime & Stone Co.	Bluffton, Ohio
Belle Center Stone Co.	Belle Center, Ohio
Higgins Stone Company	Bellevue, Ohio
Lake Erie Limestone Company	Youngstown, Ohio
Lake Erie Limestone Company	Lowellville, Ohio
Lake Erie Limestone Company	Hillsville, Pa.
Lima Stone Company	Lima, Ohio
Spencer Stone Company	Spencerville, Ohio
Union Limestone Company	Youngstown, Ohio
Ohio Marble Company	Piqua, Ohio
C. C. Beam	Melvin, Ohio
Rock Products Company	Toledo, Ohio
France Stone Company	Holland, Ohio
France Stone Company	Monroe, Mich.
Swint Stone Company	Fremont, Ohio
J. E. Baker Company	Bainbridge, Lancaster Co., Pa.
J. E. Baker Company	White Hall, Baltimore, Md.
New Castle Lime & Stone Company	New Castle, Pa.
New Castle Lime & Stone Company	Dunbar, Pa.
Lehigh Stone Company	Ormrod, Pa.
Stowe Trap Rock Company	Pottstown, Pa.
Carbon Limestone Company	Hillsville, Pa.
Blue Stone Quarry Company	Gwynedd Valley, Pa.
Whiterock Quarries	Pleasant Gap, Pa.
Connecticut Quarries Company	Rocky Hill, Conn.
New Haven Trap Rock Company	New Haven, Conn.
Edward Balf Company	Hartford, Conn.
John S. Lant and Son	Westfield, Mass.
West Roxbury Trap Rock Company	West Roxbury, Mass.
Old Colonial Crushed Stone Company	Quincy, Mass.
Rowe Contracting Company	Malden, Mass.
Simbrico Stone Company	West Roxbury, Mass.
Casper Stolle Quarry & Construction Co.	East St. Louis, Ill.
Consumers Company	Lemont, Ill.
Federal Stone Company	LaGrange, Ill.
Michigan Limestone & Chemical Company	Rogers City, Michigan
Biesanz Stone Company	Winona, Minn.
Meshberger Bros. Stone Company	Berne, Ind.
Hy-Rock Products Company	Mareago, Ind.
Fanwood Stone Crushing & Quarry Co.	Fanwood, N. J.
Samuel Braen	Patterson, N. J.
Orange Quarry Company	West Orange, N. J.
Granite Rock Company	Logan, Calif.
Daniel Contracting Company	San Francisco, Calif.
Deitz Hill Development Company	Kansas City, Mo.
Rock Hill Quarries Company	St. Louis, Mo.
Texas Trap Rock Company	San Antonio, Texas
Dittlinger Lime Company	New Braunfels, Texas
James Stone Company	Corsicana, Texas
Franklin Limestone Company	Nashville, Tenn.
Gager Lime Company	Sherwood, Tenn.
John H. Wilson	Honolulu, Hawaii

CANADA

J. A. Bourbonnaie	Vaudreuil, Que.
Canada Crushed Stone Corp.	Puslinch, Ont.
Coast Quarries	Vancouver, B. C.
Dufferin Construction Company	Innerkip, Ont.
Gordon Crushed Stone Company	Hagersville, Ont.
Thomas Langton Crushed Stone	Collwater, Ont.
LaCle A. Desrosiers, Ltd.	Montreal, Que.
Puslinch Quarries, Ltd.	Puslinch, Ont.
Quinn Stone and Ore Company	Ft. William, Ont.
Rigand Granite Products Company	Rigand, Que.
Stone and Son	Ingersoll, Ont.
Standard Lime Company, Ltd.	Joliette, Que.
Walker Bros.	Thorold, Ont.
Warden King Company, Ltd.	Montreal, Que.

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The Connecticut Quarries Co., New Haven, Conn., operating eight crushing plants—have used "Indian" Manganese Steel for over ten years—Read what Mr. Worthen, Vice - President, says about our product:

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After Handling 525,000 Tons

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November 23, 1931.

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The Dipper was received at our Plainville Quarry and put into service in June, 1928. It has been in continuous service during our operating season since that time and a report from our Plant Superintendent, Mr. R. D. Brewer, shows that the Dipper has handled 525,000 tons of Trap Rock and is still in good condition. The results obtained from this Dipper were so satisfactory that we ordered a duplicate last year for use on a similar shovel.

We have used your "Carlisle" Reversible Point Dipper Teeth at our various Quarries for a number of years and have found them entirely satisfactory.

We are also very glad to report that other "Indian Brand" Manganese Steel parts such as Jaw Plates, Concaves, Mantles, Sprockets, Chain, and Chute Liners which we have purchased from you from time to time over a period of years have given us satisfactory service in all instances.

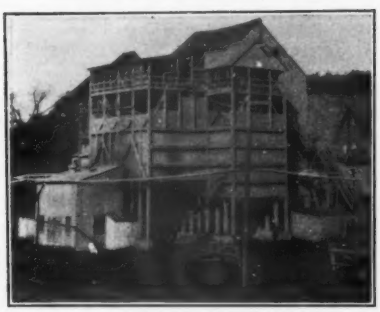
Yours very truly,

THE CONNECTICUT QUARRIES COMPANY, INC.

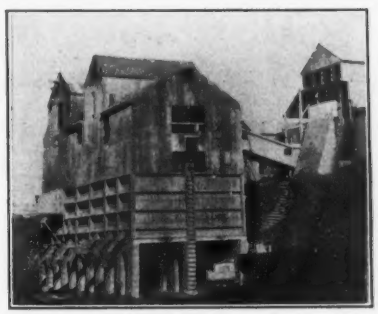
ALW/B

A.L. Worthen, Vice President.

Mt. Carmel Plant



Plainville Plant



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"Indian" Manganese Steel Parts WEAR LONGER

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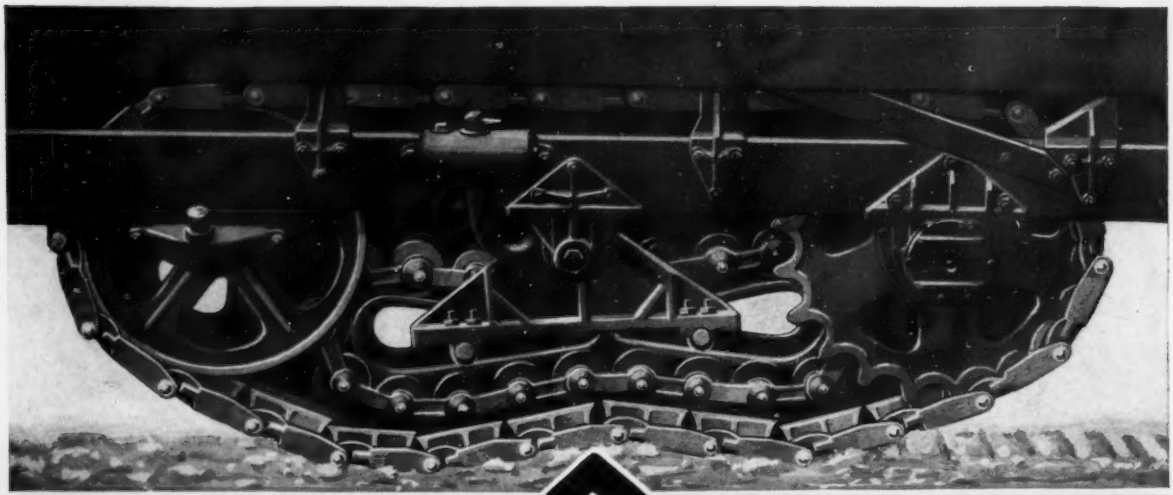
LINN saves time of turning



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The Crushed Stone Journal

Official Publication of the NATIONAL CRUSHED STONE ASSOCIATION

J. R. BOYD, Editor

Contents

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NATIONAL CRUSHED STONE ASSOCIATION
Editorial and Advertising Office
1735 Fourteenth Street N.W.
Washington, D. C.

PITTSBURGH IS EXPECTING YOU

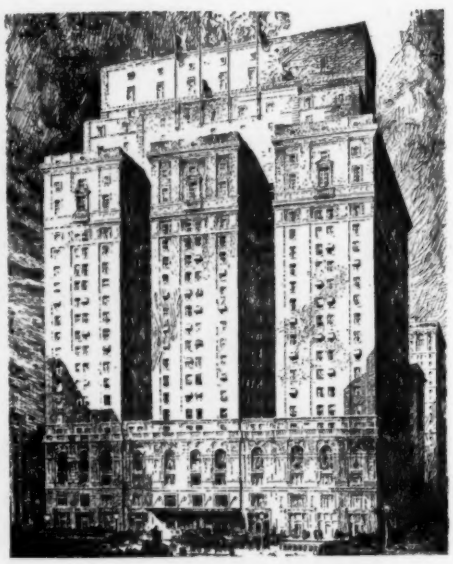
Fifteenth Annual Convention

National Crushed Stone Association

JANUARY 19, 20, 21, 22, 1932

Hotel William Penn

Where all Meetings and the Exposition will be held.



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THE CRUSHED STONE JOURNAL

WASHINGTON, D. C.

Vol. VIII No. 1 JANUARY, 1932

President Worthen Issues Last Call for Pittsburgh

◆ The complete Convention Program offers convincing proof of the necessity for every producer to be present at the Pittsburgh Convention.

THE annual meeting of the National Crushed Stone Association will be held at the Hotel William Penn in Pittsburgh, Pa., January 19-22, 1932. This is a yearly gathering of the industry to which everyone interested directly or indirectly in the production of crushed stone is cordially invited. At the present time this meeting is the only medium whereby the industry may be brought together for a discussion of its common problems and for developing ways and means to advance the welfare of the industry and improve the position of the individual producer.

This annual convention, coming at the beginning of the year, offers an excellent opportunity to determine what helpful and constructive steps can be taken in anticipation of a season immediately ahead, but at no time in the history of our Association has it been so important that the problems of industry be openly and thoughtfully discussed as now.

The present condition of this country is a result, in some degree at least, of a lack of confidence on the part of its citizenry. To emulate Pollyanna will not bring about an immediate return of prosperity, but to continue to live in an atmosphere of gloom is the surest means to a continuation of present business conditions.

Come to Pittsburgh to the Convention. You will enjoy talking over common problems and it is certain that you will learn something about your business which had never occurred to you before.

The Manufacturers' Division Exposition will afford you an excellent opportunity to see and hear about the latest developments in quarry equipment and machinery. Those of you who are alive to the situation realize that modern equipment is now more than ever before an essential requirement for efficient and economical plant operation. If you are a producer of crushed stone I urge you to attend the annual meeting of the National Crushed Stone Association and warn you that you cannot afford to stay away. The entire program will be educational and inspirational and who can deny the need for inspiration in these times of gloom and pessimism.

Trade associations are destined to play an increasingly important role in the future development of industry and it behooves every manufacturer to interest himself in the activities and policies of his trade association.

Every possible effort has been made to make the Pittsburgh Convention program of unusual interest and value, and I believe that an inspection of the convention program which follows will convince even the most skeptical that the one place in the United States where he can be of the most service to himself and to the industry of which he is a part is at Pittsburgh, Janury 19-22. It would be unfortunate if some crushed stone producers who are not members of the National Association should feel that because of this they will not be welcome at the convention; so again, even though I repeat, I wish to most cordially invite all who are interested in the crushed stone industry to be present in Pittsburgh and share with us the many privileges and pleasures of the Fifteenth Annual Convention of the National Crushed Stone Association.

PITTSBURGH CONVENTION PROGRAM

TUESDAY, JANUARY 19

MORNING SESSION

A. L. Worthen, President, Presiding

10:00—Address of Welcome—John S. Herron, President, City Council of Pittsburgh.

10:15—Response for the Association—F. O. Earnshaw, Carbon Limestone Co., Youngstown, Ohio.

10:25—Presidential Address—A. L. Worthen.
10:45—Reports of Directors on Business Conditions in 1931 and Outlook for 1932.
11:45—"Why Are We Here?"—J. R. Boyd, Secretary, National Crushed Stone Association.
12:00—Appointment of Convention Committees.
12:10—Announcements.
12:15—Adjournment.

GREETING LUNCHEON

Arthur S. Lane, John S. Lane and Son, Inc., Meriden, Conn., Presiding

1:00—Everyone, including active and associate members, as well as guests, is cordially invited to attend.

"The Value of Good Roads"—John S. Fisher, ex-Governor of Pennsylvania.

TUESDAY, JANUARY 19

AFTERNOON SESSION

W. R. Sanborn, Lehigh Stone Co., Kankakee, Ill., Presiding

2:30—"Methods of Reclaiming Old Macadam Roads"—H. P. Chapman, Asst. Director and Chief Engr., Ohio Department of Highways, Columbus, Ohio.
2:50—Discussion.
3:05—"Modern Usages of Ancient Inherited Mental Tendencies"—Dr. H. S. Hulbert, Psychiatrist, Chicago, Ill.
3:25—Discussion.
3:40—"Science in Industry"—Dr. George D. Beal, Asst. Director, Mellon Institute, University of Pittsburgh, Pittsburgh, Pa.
4:10—"The Activities and Program of the Research Advisory Committee"—P. B. Reinhold, Chairman.
4:30—Discussion—Led by A. T. Goldbeck, Director, Bureau of Engineering, National Crushed Stone Association.
4:50—Announcements.
5:00—Adjournment.

TUESDAY EVENING

7:30—Formal opening of the Manufacturers' Division Exposition of Quarry Equipment, Machinery and Supplies—Exposition Hall, William Penn Hotel.

WEDNESDAY, JANUARY 20

MORNING SESSION

Russell Rarey, Marble Cliff Quarries Co., Columbus, Ohio, Presiding

10:00—"Effect of Coarse Aggregate on the Durability of Concrete"—P. J. Freeman, Chief Engineer, Bureau of Tests and Specifications, County of Allegheny, Pittsburgh, Pa.
10:20—"The Trend in Specifications for Crushed Stone"—H. S. Mattimore, Engineer of Tests and Materials Investigation, Pennsylvania Department of Highways, Harrisburg, Pa.
10:35—"Dolomite Sand in Concrete for the Henley Street Bridge, Knoxville, Tennessee"—L. M. Dow, Designing and Supervising Engineer, Knoxville, Tenn.
10:55—Discussion—Led by Robert L. Fox, City Engineer, Bethlehem, Pa.
11:10—"A Plan for Stabilizing the Highway Building Program"—Chas. M. Upham, Engineer-Director, American Road Builders' Association, Washington, D. C.
11:30—Discussion.
11:45—Announcements.
12:00—Adjournment.

WEDNESDAY, JANUARY 20

LUNCHEON AND AFTERNOON GROUP MEETINGS

Meeting of Cost Accountants

W. E. Hilliard, New Haven Trap Rock Co., New Haven, Conn., Presiding

1:00—Luncheon.
2:30—General Discussion of Association's Manual on Uniform Cost Accounting.

Sales Problems

J. A. Rigg, Acme Limestone Co., Alderson, W. Va., Presiding

1:00—Luncheon.
2:30—"Do You Know?"—A. T. Goldbeck, Director, Bureau of Engineering, National Crushed Stone Association.
2:50—Discussion.
3:05—"The Advantages of a Uniform Sales Contract"—John Rice, Jr., General Crushed Stone Co., Easton, Pa.
3:25—Discussion—Led by Ellwood Gilbert, New Castle Lime and Stone Co., New Castle, Pa.
3:40—"Truck Delivery and Its Responsibilities"—John B. Lockhart, Attorney, New Castle, Pa.
4:00—Discussion—Led by Quincy McBride, representative, Aetna Insurance Co., New Castle, Pa.
4:20—General Discussion.
4:35—Open Forum.
5:00—Adjournment.

Meetings of Local Associations and Annual Meeting of Manufacturers' Division

6:30—New England Crushed Stone Association—Dinner Meeting.
6:30—New York State Crushed Stone Association—Dinner Meeting.
6:30—Pennsylvania Stone Producers' Association—Dinner Meeting.
6:30—Manufacturers' Division Annual Business Dinner Meeting.

WEDNESDAY EVENING

"PENNSYLVANIA NIGHT"

8:30—A distinctly different evening planned and presented through the courtesy of the Pennsylvania Stone Producers' Association. This is a stag affair, the ladies being entertained by the same Association this evening with a Theatre Party.

THURSDAY, JANUARY 21

MORNING SESSION

John Prince, Stewart Sand and Material Co., Kansas City, Missouri, Presiding

10:00—"Airport Pavement Requirements"—Fred E. Swineford, Chief Engineer, Ohio Crushed Stone Association, Columbus, Ohio.
10:20—Discussion.
10:35—"The Swope and Related Plans for Business Stabilization"—Dr. Ralph J. Watkins, Director, Bureau of Business Research, University of Pittsburgh, Pittsburgh, Pa.
10:55—"Legality of Sales Mergers"—Gilbert H. Montague, Attorney-at-Law, New York City.
11:15—"Business Stabilization and the Anti-Trust Laws"—Harold Williams, Member of the Boston Bar, Boston, Mass.
11:25—Discussion.
11:35—"Why Adopt the Association's Uniform Cost Accounting System?"—Wm. E. Hilliard, New Haven Trap Rock Co., New Haven, Conn.
11:50—Report of the Nominating Committee and Election of Officers.
12:10—Greeting of President-elect.
12:20—Announcements.
12:30—Adjournment.

THURSDAY, JANUARY 21

LUNCHEON AND AFTERNOON GROUP MEETINGS

Operating Men, Superintendents and Manufacturers

W. W. Duff, New Castle Lime and Stone Co., New Castle, Pa., Presiding

1:00—Luncheon.
2:30—"Some Fundamental Considerations in the Preparation of Clean Stone."
a. Introduction—A. T. Goldbeck.
2:50—b. Methods of Washing Stone.
Harry H. Brandon, C. C. Beam, Inc., Melvin, Ohio.
H. W. Craig, John T. Dyer Quarry Co., Norristown, Pa.

(*Continued on page 12*)

Shale In Aggregates[1]

By E. F. BEAN
State Geologist, Wisconsin

♦ Shale is customarily considered a deleterious substance when present in concrete aggregates. It is pointed out, however, in the following article that the geological aspects of shale should be considered.

NEARLY all specifications for concrete aggregate directly or indirectly place shale in the list of deleterious substances. In Minnesota the tolerance is not more than 2½ per cent by weight in sand and in coarse aggregate not more than 0.4 per cent by weight of the portion between 2″ and ¾″ and not more than 0.7 per cent by weight of the entire sample. These limits were developed by observation of the effect of shale in concrete. Michigan permits up to 3 per cent of shale in concrete coarse aggregate.

It has appeared to the Committee on Correlation of Research in Mineral Aggregate that the geological aspects of shale should be considered. This paper, therefore, will discuss the origin and characteristics of shale and its metamorphic equivalents from the standpoint of highway aggregates.

Clay

Clay is the fine-grained product of rock weathering. Twenhofel [2] defines clay on the basis of grain size as having particles less than 1/256 mm. in diameter and silt as consisting of particles between 1/256 mm. and 1/16 mm. in diameter. The primary source of clays is weathered igneous rocks. Clay is produced also by the decomposition of sedimentary rocks especially shale and limestone. "The minerals of the clays consist of hydrous aluminum silicates of the kaolin group, containing more or less adsorbed alkalies and alkaline earths, minerals of the chlorite group, hydrous iron oxide, secondary quartz, and opal, carbonates of calcium, magnesium and possibly iron, small amounts of sulphate (probably largely gypsum), fine-grained fragmental quartz, feldspar, micas, and ferromagnesian minerals, and very small amounts of original unaltered accessory minerals.[3]

Shale

In the sense generally employed shale is a consolidated clay, forming a close-grained rock which may be laminated with excellent parting parallel to the bedding or it may be nearly massive. Consolidation is accompanied by cementation which may be due to the crystallization of colloidal envelopes surrounding the minerals. The change is a progressive one. In the early stages, before much crystallization and dehydration have taken place the process of hardening may be reversed by soaking in water. As a rule shale slakes more readily after it has been air dried. The cretaceous shale at Red Wing, Minnesota, slakes readily in three minutes.[4] Some exposures of the Coldwater (Lower Mississippian) shale of Michigan slake more slowly. The term shale is loosely employed as a structural term to describe not only shale but also other thin bedded rocks, particularly sandstone and limestone. Since the original sediment was not in all cases pure clay, there are all gradations, with increasing sand content, between shale and argillaceous sandstone. With an increasing proportion of calcareous material shale grades into argillaceous limestone. Shales are usually soft, cut readily and are brittle. They vary greatly in color but shades of gray are the most common. Geologically shales are important since it has been estimated that 80 per cent of the sedimentary rocks are shale. Outcrops, however, are not common owing to rapid weathering. The average clay [5] has a mineral specific gravity of 2.68 and the average shale a mineral specific gravity of 2.71. Porosity of the clay is largely eliminated by compression. The average porosity of clays is 27 per cent and that of shales is but 13 per cent. The average mineral composition of shales is as follows: [6]

Quartz	31.91	Gypsum	1.17
Kaolin	10.00	Orthoclase	12.05
White Mica	18.40	Albite	5.55
Chlorite	6.40	Rutile	.66
Limonite	4.75	Apatite	.40
Dolomite	7.90	Carbon	.81

"There are, of course, wide variations from this average. The shales have a much smaller proportion of amorphous constituents than clays. The colloidal substances have largely disappeared. Kaolin and the ferric hydrates have decreased to a marked extent. The fine-grained matrix or paste of the shales consists of finely granular quartz or chert, containing considerable quantities of white mica and locally rutile. Much of the iron is reduced to the ferrous condition in combination with silicates (principally chlorite) and as carbonate. It may be combined with sulphur, which is often present under these conditions, to form pyrite. The presence of carbonaceous matter favors this reduction, as shown by the common association of iron carbonate and sulphides with granitic shales. The result is often a change of color of the rock from yellowish or reddish to greenish gray or black." [7]

[1] Presented before the Eleventh Annual Meeting of the Highway Research Board, National Research Council, Washington, D. C., December 10, 1931, and reprinted through the courtesy of the Highway Research Board.
[2] Twenhofel, W. H. Treatise on Sedimentation. P. 186.
[3] Leith and Mead, Metamorphic Geology, P. 76.
[4] Grout, Frank F. Clays and Shale of Minn. U. S. G. S. Bulletin 678, P. 169.
[5] Leith and Mead, Metamorphic Geology, P. 108.
[6] Idem, P. 76.
[7] Leith and Mead Metamorphic Geology. P. 104.

Slate

A shale becomes a slate through one or more of the following: (1) long continued pressure, (2) contact metamorphism or dynamic action or (3) through the effects of high temperature and pressure. The mineral grains are so small as not to be distinguishable to the eye. By the development of a parallel arrangement of the mineral constituents a fine cleavage is imparted, generally at an angle to the bedding. The change from shale to slate is marked by a development of the platy minerals principally muscovite and to a less extent chlorite, which are responsible for the slaty cleavage. The process of alteration may be only partial, resulting in a clay slate, having as its chief constituents clay, mica and chlorite. If the process is carried still further a mica slate results. In this little or no clay remains, the chief constituents being mica, quartz and chlorite. The most abundant mineral is white mica (sericite). Argillaceous rocks may be transformed into massive rocks, devoid of cleavage, which are chemically and mineralogically slates.

Phyllite and Schist

The word phyllite means leaf stone. Phyllites are metamorphosed slates, characterized by excellent cleavage, by means of which they split into thin sheets. The surface is sometimes flat, sometimes wavy and irregular. Mica may constitute more than 50 per cent of the weight of the rock. Mica schists may represent a continuation of the recrystallization process which developed the slate, resulting in a foliated rock with a coarser grain. The individual folia are mineralogically alike and the principal minerals are so large as to be visible to the naked eye.

Summary of Clay, Shale, Slate and Schist Relationship

Shales, slates, phyllites and mica schists, therefore, form a continuous series of rocks which can be derived from clay by progressive metamorphism (dehydration and crystallization). The general order of change from clay to schist is shown in Table 1.

There is a progressive loss of water and carbon dioxide in the change from clay to schist. Carbon dioxide has been replaced by silica which has proportionally increased as a cementing material. Ferric iron is partly reduced to ferrous state and there is an apparent gain in alumina.

Weathering

Since all the rocks in this series have been derived from the weathering of preexisting rocks, they are chemically stable, and break down under weathering largely through mechanical processes, yielding clays. Their susceptibility to destruction by weathering is determined by the degree of metamorphism—the shales having been least metamorphosed weather most rapidly. Since shale is exceedingly fine-grained, the pore spaces are subcapillary in size, water is confined and the destructive effect of freezing is much greater than in a porous sandstone. As mica slates are more resistant to absorption, and are, therefore, more resistant to weathering than clay slates, they have long been considered one of the most durable of building materials. Bowles [9] reports a slate roof in good condition after 1200 years of service.

Table 1[8]

	A	B	C	D
SiO	54.28	58.38	61.90	65.74
Al_2O_3	14.51	15.47	16.54	17.35
Fe_2O_3	6.25	4.03	2.73	1.90
FeO	.77	2.46	3.63	3.35
MgO	2.99	2.45	2.99	1.90
CaO	5.04	3.12	1.07	1.25
Na_2O	1.21	1.31	2.57	1.78
K_2O	2.12	3.25	3.15	3.28
H_2O	8.41	5.02	3.84	2.01
TiO_2	.42	.65	.82	.55
CO_2	3.53	2.64	.59	None
P_2O_5	.09	.17	.04	.12
SO_3	.08	.65	.03	.03
Ol	.02	---	Trace	Trace
F	---	---	Trace	.07
MnO	.08	Trace	Trace	.03
SrO	---	None	Trace	Trace
BaO	---	.05	.01	.05
Li_2O	---	Trace	Trace	Trace
FeS	---	---	.11	---
C	.24	.81	.22	.58
	100.04	100.46	100.24	99.99

A. Average of 12 analyses of clays and soils.
B. Average of composite analyses of 78 shales.
C. Average of 22 analyses of slates.
D. Average of 5 analyses of schists.

Shales In Aggregates

Gravel. Since shale weathers rapidly, outcrops are uncommon in spite of the fact that it is a very important sedimentary rock. Weathered shale is an important constituent of glacial till in shale areas. In areas underlain by shale, it is a relatively common constituent of gravel. The better gravels have been subjected to such vigorous abrasion that the soft unstable constituents have disappeared and only the hard and durable materials remain. Gravels, derived in part at least from areas of shale outcrop, contain a proportion of shale fragments determined by the distance transported and the amount of abrasion experienced en route. The shale in glacial gravel has been subjected to grinding within the ice, and to abrasion before

[8] Clarke, F. W. Data on Geochemistry, U. S. Geol. Sur. Bulletin, 770. p. 631.
[9] Oliver Bowles, The Technology of Slate. Bureau of Mines, Bulletin 218, P. 7.

deposition by a glacial stream. A wave cut exposure of shale furnishes pebbles to the beach. If wave action is vigorous, these pebbles are worn out during relatively short transportation along shore. The percentage of shale pebbles in stream gravels decreases rapidly upon transportation away from the ledge.

A study of the aggregate in the weathered zone of gravel exposures gives much data regarding shale. Here all of the material has been subjected to a service test. An original shale pebble may be represented by small chips or by a mass of clay. In recently worked portions of the deposit, the shale pebbles may appear quite hard and sound, since they have not been exposed to alternate wetting and drying and to freezing and thawing.

While there are all gradations between shale and mica schist, the most common problem in the field is to differentiate shale from slate. A simple test is to grind the specimen to powder and mix it with water. Shale subjected to this treatment becomes a soft plastic mass, while slate does not. In the outcrop, shales weather to clay while slates tend to break into angular fragments of varying size.

With shale present in gravel there is some possibility of removing it in the plant, but the following data regarding specific gravity of various types of rock indicate that there will be considerable difficulty in effecting complete separation by any method that depends upon relative specific gravities.

Specific Gravity of Wisconsin Stone [10]

	Average	Maximum	Minimum
Granite	2.655	2.713	2.629
Dolomite	2.808	2.856	2.740
Sandstone	2.631	2.660	2.524

Average Specific Gravity of Rock Samples [11]

Basalt	2.86	Sandstone	2.56
Granite	2.66	Mica Schist	2.77
Limestone	2.65	Slate	2.76
Dolomite	2.72		

The specific gravity of 9 samples of shale [12] is as follows: Maximum 2.70, minimum 2.50, average 2.56. The specific gravity of 18 Iowa shales [13] is as follows: Maximum 2.64, minimum 2.25, average 2.45.

A system of grinding which would destroy the shale and the friable particles might be effective, providing the cost were not excessive. This would reproduce in the plant, Nature's method of destroying such material.

Quarries. If a limestone quarry is under consideration the weathered ledge should be carefully examined for evidence of shale. Thin beds of limestone or dolomite are usually separated by thin laminae of shale. Even massive beds decrepitate upon weathering because of paper thin shale partings. Loughlin [14] ascribes the failure of a western Pennsylvania limestone to clay and organic matter in irregular spots. The clay mineral was beidellite. Chemical analyses of limestone are a valuable indicator of the clay content. By a studied selection it is possible to eliminate in quarrying the undesirable stone, thus bringing the crushed product up to requirements. The service history of quarried stone is a valuable source of information. Many quarries have been in use for many years and buildings of long standing indicate the quality of the stone. It must be remembered that care has usually been exercised in selection so that only the more durable beds were utilized.

[10] Buckley, E. R., Building and Ornamental Stones, Wis. Geol. Survey, Vol. 4, P. 371.
[11] Bulletin 348, U. S. Department of Agriculture, Table 1.
[12] Reis and Watson, Engineering Geology, P. 601.
[13] Iowa Geol. Survey, Vol. 14, P. 116.

Slates and Schists As Aggregates

Slates and schists are composed of minerals very resistant to atmospheric weathering. These rocks are, therefore, sound, but are usually undesirable as road materials for structural reasons. Tests of Pennsylvania slate [15] showed the following results:

Porosity per cent	0.196
Tensile Strength lbs. per sq. in.	3,625
Compression Strength per sq. in.	10,250
Abrasion, per cent of wear	5.12
Abrasion, French Coefficient	7.81
Toughness	11.5
Hardness Coefficient	11.0

The tendency of these rocks to produce flat and elongated fragments is considered objectionable. Thin bedded limestones and sandstones are subject to the same objection.

[14] Loughlin, G. E. Qualifications of different kinds of natural stone for concrete aggregate. Am. Con. Inst., Proceedings, Vol. 23, Pp. 319-351.
[15] Oliver Bowles, Technology of Slate. Bureau of Mines, Bulletin, 218, P. 7.

Widening and reconstructing highways and surface treatment specifications will be studied by committees of the county highway officials' division of the American Road Builders' Association and reports presented at the 29th annual Convention and Road Show in Detroit in January.

The studies on widening and reconstructing begun in 1930 and reported at the 1931 convention will be continued. Information will be supplied to support application of the principles previously outlined and special attention will be given to new features which have been developed and which are suitable for general application.

Surface treatment specifications will be considered in two parts: materials and construction methods.

Many counties contain large mileages of untreated surfaces which are in excellent condition to receive surface treatment. Surface treatment of these roads will improve their serviceability, reduce maintenance costs and enable them to carry increased traffic volume.

Standardization of tests and specification limits will remove the handicaps in comparing products and assist in extending their use.

Progress in Safety at Quarries[1]

By W. W. ADAMS

Chief Statistician, Demographical Division, United States Bureau of Mines, Washington, D. C.

◆ Accident prevention continues to be an important activity in the crushed stone industry and it should be gratifying to learn from the following article that very real progress is being made in the reduction of accidents.

NINETEEN-THIRTY was a good year for the quarry industry so far as the prevention of accidents is concerned. In fact it was the best year that the industry has ever experienced. Only once before has the death rate been as low as it was last year, and the rate for non-fatal injuries was the lowest since complete records of injuries have become available.

Employment was not as good as in 1929. This is not surprising, in view of the general industrial conditions that prevailed last year. Measured by the number of man-shifts worked, employment was 10 per cent lower than the previous year's level. The average employee worked 255 days, or 13 days less than in 1929.

A reduction in employment means a smaller amount of exposure to accident-hazards; therefore it was reasonable to expect that fewer men would be injured in 1930. As a matter of fact fewer men *were* injured, and the reduction in the number of injuries was proportionately greater than the reduction in employment. Employment declined 10 per cent; the number of accidents declined 24 per cent. Accidents dropped from a rate of 130 per thousand 300-day workers in 1929 to only 110 per thousand 300-day workers in 1930. In other words, the accident-frequency rate was reduced 15 per cent. When it is recalled that a one per cent reduction in the accident rate was recorded in 1929 as compared with 1928, and that the 1928 rate was 20 per cent lower than that of the year before, a further reduction of 15 per cent in the rate for 1930 is an accomplishment that indicates a growing interest in safety on the part of stone producers of the country.

The marked reduction in the accident rate last year is notable because of the conditions under which it was accomplished. Safety often suffers a set-back during times of irregular employment or part-time operation, a condition that prevailed so widely in 1930. When such conditions prevail, the morale of the employees is lowered, the men worry over inadequate or uncertain income, and often both men and management pay less attention to good-housekeeping from a safety point of view. These factors often lead to an increase in the accident rate among employees, yet in 1930 we find an entirely different result. Accidents were not only fewer in number than in the preceding year, but the frequency rate per thousand 300-day workers was also lower than in 1929. It is probable that the conditions from which quarrying and other industries suffered last year had the effect of weeding out many accident-prone employees and those otherwise inefficient, and of retaining on the payroll, for such work as was available, the more efficient workers. As efficient workers are usually the safest workers, this seems to me to be the most probable cause of much of the progress in safety made under the unusual conditions that prevailed in 1930.

Last year's progress in safety was not confined to any one kind of quarrying. All branches of the industry shared the improvement. Outstanding in accomplishment was the progress made by quarries and mills engaged in the manufacture of cement. This branch of the industry led all others by reducing its accident rate 22 per cent. Limestone quarries not connected with the cement industry ranked second with a reduction of nearly 17 per cent. Tying for third place in the amount of progress made were trap-rock quarries and granite quarries, each of these groups having a reduction of 13 per cent in its accident rate as compared with the rate for the year before. Next in order were sandstone and bluestone quarries with a reduction of more than eight per cent in accident-frequency. Then came slate quarries whose progress amounted to 7.6 per cent. Marble quarries came last with a reduction of 4 per cent in the accident rate.

These figures represent progress only; they do not represent the relative hazards of the several classes of quarries, but rather a step made by each group in 1930 over its own position in the previous year.

The accident-frequency rates for each class of quarries in 1930 and 1929, also the per cent of reduction represented by the rate for 1930, are shown by the following figures:

ACCIDENT RATES PER THOUSAND 300-DAY WORKERS AT QUARRIES, 1929 AND 1930, AND PER CENT OF REDUCTION OF 1930

Kind of quarry	*Accident rate*		*Per cent of decrease in 1930*
	1929	*1930*	
Cement	44.68	34.96	21.8
Limestone	173.33	144.55	16.6
Trap rock	223.00	193.64	13.2
Granite	166.34	144.50	13.1
Sandstone and bluestone	135.38	124.30	8.2
Slate	165.22	152.61	7.6
Marble	96.41	92.48	4.1
Total	129.79	109.76	15.4

These figures showing an average of 15 per cent reduction in the accident rate for 1930 also show that the reduction ranged from 4 per cent for marble quar-

[1] Presented before the Quarry Section Meeting at the Twentieth Annual Safety Congress, Chicago, Ill., October 12-18, 1931.

ries to 22 per cent for quarries producing stone for the manufacture of cement. It is well-known that the cement industry has long been a leader in accident-prevention work.

Now what did the individual States accomplish? How widely distributed was last year's progress?

Stone is quarried in nearly all States of the Union. Yet in only 13 States is the quarry industry of such magnitude as to require the services of as many as 2,000 men. These 13 States taken together represent approximately 70 per cent of the entire industry, when measured by the number of men employed. When considered as a group, they had fatality and injury rates that were slightly more favorable than the rates for the smaller States.

The following figures show how these 13 important States stood in 1930 and 1929, based upon their accident-frequency rates:

ACCIDENT RATES PER THOUSAND 300-DAY WORKERS AT QUARRIES IN THE 13 PRINCIPAL QUARRYING STATES IN 1930 COMPARED WITH 1929, AND PER CENT OF REDUCTION IN 1930

State	*Accident rate* 1929	1930	*Per cent of decrease in 1930*
Georgia	127.12	65.00	48.9
Illinois	116.40	69.19	40.6
Alabama	167.70	102.13	39.1
Ohio	128.33	92.11	28.2
Michigan	79.29	58.28	26.5
Missouri	218.82	167.57	23.4
Tennessee	119.55	99.75	16.6
New York	133.67	117.12	12.4
Indiana	99.12	90.61	8.6
Pennsylvania	95.07	94.66	0.4
California	159.18	164.17	3.1 (increase)
Vermont	100.75	108.14	7.3 "
Massachusetts	208.32	258.21	23.9 "

It will be observed that ten out of the 13 States lowered their accident rates in 1930. The reductions ranged from nearly 49 per cent in Georgia to less than one per cent in Pennsylvania. Three of the thirteen States suffered an increase in their accident rates; these were California, 3 per cent; Vermont, a little over 7 per cent; and Massachusetts, nearly 24 per cent.

Anyone who is more than casually interested in the prevention of accidents, wants to know how much progress is made or lost each year as compared with the year before. Yet a comparison of the current year with only the preceding year does not always indicate trends.

Let us see how the quarry industry fared in 1930 as compared with five years ago. If we take 1925 as a point of beginning and compare the record for that year with the record for 1930, we find a reduction of 36 per cent in the accident-frequency rate during the latter year. Thirty-six per cent reduction in the accident-rate as compared with five years ago; 15 per cent reduction as compared with one year ago. Certainly the quarry industry as a whole is making rapid strides in the prevention of accidents.

How true this statement is may be seen by considering what the death and injury losses of the industry would have been if the accident rate of five years ago had continued to the present time. In 1925 there were 1.78 men killed and 170 men injured for every 300,000 man-shifts of labor performed. During the five years since that record was made, the quarry industry has worked more than 117 million man-shifts. In connection with this work 639 lives have been lost and 54,455 men have been injured by accidents. These losses are lamentable from any point of view, but they are not as great as they would have been if the 1925 rate had continued. If the quarry industry had not been able to lower its accident rate since 1925 there would have been 58 more men killed and 11,951 more men injured than the record actually shows. And yet we occasionally hear the question asked, "Does accident-prevention work pay?"

Let us look at this saving from the viewpoint of wages saved. To be sure, there are other points of view, but at this moment look at wages only. The average age of men killed in industrial accidents is 25 years. A man 25 years old may reasonably expect to remain useful in industry for 20 years more. As quarries normally average 250 workdays a year, the saving of 58 lives during the past five years means a saving of $1,450,000 in wages to these 58 men and their families, assuming an average wage of $5 a day. This amounts to a saving of $25,000 in wages for each of these 58 men over a life-expectancy of 20 years that would have been destroyed if the industry had made no progress in the prevention of accidents during the past five years.

Now what of the 11,951 who would have been injured if quarry operators had made no progress in safety?

When men are injured by accidents in quarries, the average period of disability is 18 days. At $5 a day the prevention of these accidents means a saving of $1,075,590 in wages to these men who otherwise would have been injured. This saving is conservatively estimated because I am assuming that the injuries which might have occurred would not have included any cases of permanent or partial disability.

It may, therefore, reasonably be said that safety work at quarries during the past five years has resulted in saving $1,450,000 in wages to 58 men who would have been killed and $1,075,590 in wages to 11,951 men who would have been injured if the quarry industry had made no progress in the prevention of accidents.

Continued interest in safety is the surest guarantee of continued progress in the prevention of accidents. Intermittent interest is almost sure to be reflected in higher accident rates. In this connection consider one other thing which the quarry industry has done. Take as an illustration those companies that have been enrolled in the National Safety Competition which is conducted annually by the United States Bureau of Mines. These annual safety contests cover both mines and quarries. The first contest was in 1925 and there has been a marked increase in the number of com-

panies enrolled since then. In fact, if the number of companies enrolled may be taken as a gauge of an industry's interests in the prevention of accidents, the quarry industry is more alive to the safety of its workers than any other group represented in these yearly safety competitions.

The contests cover not only quarries, but coal mines, metal mines, and other classes of mines, and quarries comprise about half of the total enrollment. In the first year's contest 103 quarries entered the contest; this number has increased to 201 during the present year, 1931. These quarry companies employ about one-fourth of the total number of all quarry-pit workers in the United States. To a considerable degree, therefore, the accident experience of these companies is a fair sample of the experience of the whole quarrying industry.

The companies taking part in the National Safety Competition have established an enviable safety record. Some of the companies have been participating every year since 1925; others have enrolled in later years. Considering all of them as a group from year to year, there has been uninterrupted downward trend in the accident-frequency rates during the six years during which the contests have been conducted. The progress made has been most impressive. In the first year, accidents were occurring at these quarries at the rate of 48 accidents for every million man-hours of exposure; during the last year, 1930, accidents occurred at the rate of only 22 accidents per million man-hours of exposure. The annual rates were as follows:

1925	48.259
1926	43.241
1927	33.537
1928	29.327
1929	26.782
1930	22.073

In view of the fact that records covering the entire quarry industry in the United States show a 36 per cent reduction in the accident-frequency rate since five years ago, and that records covering all quarry companies in the National Safety Competition show a 54 per cent reduction during the same period, no better evidence can be produced of the widespread interest of operators in the prevention of accidents and of the effectiveness of the industry's efforts to protect the employees from injury.

President Worthen Issues Last Call for Pittsburgh

(*Continued from page 6*)

3:15—c. Other Methods of Cleaning Stone.
F. W. Schmidt, Jr., North Jersey Quarry Co., Morristown, N. J.
3:40—"Some Pertinent Comments on Loading and Transportation"—W. E. Farrell, Easton Car and Construction Co., Easton, Pa.
4:00—Open Forum.
4:30—Adjournment.

Meeting of the National Agricultural Limestone Products Association, Inc.

F. O. Earnshaw, President, Presiding

1:00—Luncheon.
2:30—"The Trade Association as a Stabilizer"—Burton A. Ford, New York City.
3:00—Annual business meeting and election of officers.

THURSDAY EVENING
ANNUAL BANQUET
BALLROOM—WILLIAM PENN HOTEL
7:30 P. M.

Presentation of Awards for National Crushed Stone Association Safety Contest—Scott Turner, Director, U. S. Bureau of Mines
Remarks of Acceptance—E. M. Gould, Superintendent, Cape Girardeau Limestone Quarry, Marquette Cement Mfg. Co., Cape Girardeau, Mo., Winner of the Contest for 1930
Address—Hon. James M. Beck, U. S. Congressman from Pennsylvania.
"Summing it Up"—Douglas Malloch, "The poet who makes living a joy," Chicago, Ill.

FRIDAY, JANUARY 22
MORNING SESSION

A. L. Worthen, President, Presiding

10:00—"Premixed and Delivered Concrete Has a Large Field in Municipal Work"—Henry D. Johnson, Jr., Construction Engineer, Division of Bridges and Structures, Department of Public Works, Pittsburgh, Pa.
10:20—"Manufacturing and Selling Ready Mixed Concrete"—J. L. Shiely, President, J. L. Shiely Co., St. Paul, Minn., and Treasurer, National Ready Mixed Concrete Association.
10:40—Discussion—Led by J. E. Burke, General Manager, The Ready Mixed Concrete Co., Pittsburgh, Pa., and President, National Ready Mixed Concrete Association.
10:55—"Start from Where You Stand"—W. B. Burrus, Internationally Known Business Counsellor, Washington, D. C.
11:15—"Present Trends in Railroad Ballast Specifications"—A. P. Crosley, Chairman, Committee II—Ballast, American Railway Engineering Association, and Division Engineer, Reading Company, Harrisburg, Pa.
11:35—Discussion—Led by A. T. Goldbeck.
11:50—Report of Transportation Committee—W. R. Sanborn, Chairman
12:00—Report of Committee on Resolutions.
12:10—Report of Auditing Committee.
12:15—"Highlights of the Convention"—Otho M. Graves, General Crushed Stone Co., Easton, Pa.
12:35—General Business.
12:45—Installation of Officers.
12:50—Adjournment.
1:00—Farewell Luncheon.
2:30—Meeting of the Board of Directors.

Ladies' Entertainment Program

TUESDAY, JANUARY 19

10:00—Opening of Convention.
3:00 to 5:00—Get-acquainted Tea.
7:30—Opening of Manufacturers' Division Exposition.

WEDNESDAY, JANUARY 20

10:30—Inspection of J. L. Heinz Company plant with luncheon at the plant. Immediately following the luncheon there will be a visit to the Carnegie Museum and a short tour of the City of Pittsburgh, returning to the hotel about 4:30.
8:00—Theatre Party.

THURSDAY, JANUARY 21

10:30—Shopping tour of Kaufman's Department Store. Luncheon will be served at Kaufman's followed by a style show in the afternoon.
7:30—Annual Banquet.

Committee on Arrangements
MRS. F. O. EARNSHAW, *Chairman*
MRS. WM. M. ANDREWS
MRS. PAUL B. REINHOLD
MRS. BRUCE G. SHOTTON

An Inventory of Highway Transportation[1]

By W. R. SMITH

President, Lane Construction Co., Meriden, Conn., and President of the American Road Builders' Association

◆ When it is considered that the public investment in highway transportation approximates thirty billion dollars, the facts and figures presented in Mr. Smith's "inventory" should prove of very real interest.

ORDERLY progress and the necessity of balancing costs against returns in any business make a periodical inventory necessary. This is particularly true of highway transportation because the roads over which vehicles run are owned and administered by the general public which demands an exact accounting.

Over the public highways are operated vehicles used for recreation, private business, and the hauling of people and goods for profit. This traffic has grown faster than highways could be provided during the past decade. There has been an under-production of highways. The present cost of transportation on improved roads and streets must be compared with the cost on unimproved highways to get a clear picture of the facts and figures in our inventory.

Let us examine some of the facts and figures about transportation by highway. Only a few years ago highway travel was slow, expensive, and laborious depending on animals for power and hindered by poor roads. Costs of transportation were as high as 25 cents per ton-mile over the best roads of the day as contrasted with 6 cents per ton-mile over modern improved highways. The speed of travel has increased at least ten-fold, or from 5 miles an hour to 50 miles an hour. The cost and difficulties of maintaining power horses that consumed almost as much food when idle as when working must be contrasted with the modern motor that uses no fuel when not at work.

The pleasure travel bill by motor vehicles last year amounted to $3,200,000,000 in the United States according to figures of the American Automobile Association. This money was spent in all parts of the country for necessities incident to travel.

The public investment in motor vehicles and in roads and streets on which they operate now approximates 30 billion dollars, or more than the total investment in railroad tracks and rolling-stock. Highway activities considered as an operation owned by the public and operated for public welfare is the largest public utility in the United States. This investment of public money must be maintained at proper working efficiency, and additions made to the useful system to reduce the cost of transportation as well as to facilitate the speed and comfort of travel.

Let us view a few figures as to where we stand on road and street building. There are some 3,000,000 miles of country roads in the United States, and probably not less than 250,000 miles of city streets. Of the 3,000,000 miles of country roads, only 700,000 miles have been surfaced to provide a firm roadbed for vehicles. City streets have a higher percentage of improvement. Of the 700,000 miles of surfaced roads, about 200,000 miles are state highways and 500,000 miles are roads of local use. The Federal government has paid part of the cost of building only 88,000 miles of state roads, of which 51,000 miles are of pioneer type without strong surfaces. It is seen, therefore, that the building of a complete highway system to care for the 26 million motor vehicles in the United States hardly has more than begun.

In 1902 the total mileage of improved roads was but 150,000 and the registration of motor vehicles was 23,000, or six miles of road per automobile. Today the mileage of improved roads is 700,000, or 37 vehicles per mile of road. We have passed from a condition of freedom of travel to a situation where the roads are congested with traffic. Proof of this statement may be obtained from almost any automobile driver—especially a Sunday driver. Further proof is in the accident record last year when 33,000 people were killed and nearly a million injured in highway accidents.

The economy of improved highways may be illustrated by a simple example. Extensive research work has shown that the operating cost of an average motor vehicle is 2 cents a mile greater on an unimproved highway than on a surfaced road. It is clear, therefore, that an unimproved highway carrying 1,000 vehicles a day costs the vehicle owners $20 a mile in increased operating costs more than they would have to pay on a surfaced road. In a year this loss amounts to $7,300, sufficient to pay the cost and maintenance on a $93,000-per-mile highway, or several times the cost of the best type of highway.

Let us approach the matter of economy from another direction. Just how much has the public saved by improving 700,000 miles of surfaced highways? The gasoline consumption in 1930 was 15 billion gallons. Half this fuel probably is used in vehicles traveling on surfaced roads, so that vehicles traveling only 12 miles on a gallon traversed 90 billion miles of highways. From this figure of 2 cents a mile saved to the vehicle driver because of the improvement of the high-

[1] Presented at the National Transportation Dinner of the American Society of Automotive Engineers, Thursday, October 29, 1931, at the Shoreham Hotel, Washington, D. C.

ways, it appears that the saving to the public due to the surfaced roads is $1,800,000,000 annually. This sum would have been paid out by the traveling public had the roads not been surfaced. The money saved is more than is expended on roads, a large part of which goes for capital investment in more improved roads, which, in turn, save more dollars for the taxpayers.

What part of the freight and passenger business of the United States are these highways carrying? Commercial freight traffic in the United States handled by all transportation agencies amounted in 1929 to 650 billion ton-miles according to figures of the Interstate Commerce Commission. This freight was handled as follows: steam railroads, 75.8; electric railroads, motor trucks, airplanes, 3 per cent; pipe lines, 4.9 per cent; inland waterways, 16.3 per cent. Motor truck transportation is an almost unappreciable part of the total freight movement. Moreover, it is estimated by the chief of the United States Bureau of Public Roads that the maximum capacity of the highways for motor freight is 100 billion ton-miles, only 15 per cent of the total commercial tonnage moved in 1929.

Many railroads are operating motor freight and bus lines. In 1930 about 80 railroads operated 4,000 buses and 60 railroads operated 7,000 trucks. The property investment of railroads in motor freight equipment was about $40,000,000 in 1930.

Travel on railroads in 1929 amounted to 31 billion passenger miles; the travel on highways, based on gasoline consumption of 12 miles per gallon and two passengers per car, is about 300 billion passenger-miles.

The ideal situation as stated by officials of the Interstate Commerce Commission would be for passengers and freight to be handled by the most economical transportation agency. Today there are many forms of transportation, each offering certain advantages for the shipper or the traveler. The interests of the public should be considered of first importance in any matter of transportation.

At the present time there is need to put men to work and to start the wheels of industry turning. The money expended on roads and streets this year employed more than a million men and it is estimated that two million others are busy furnishing materials, equipment, and supplies to road workers. Federal aid and state road building this year exceeded a billion dollars and employed 380,000 men; county and township road work expended in excess of two-thirds of a billion and probably as many men were at work because of its diversified character; city paving, somewhat reduced this year, had almost as many men on the payrolls.

Analysis of the dollar spent in road and street building projects increases the national wealth—a wealth that belongs to the public rather than to individuals. The results of money spent for roads and streets will remain long after the depression has passed.

So in taking even such a rough inventory as we have made, it appears clearly that true economy lies in the improvement of the 2,300,000 miles of roads that are yet unsurfaced. This improvement must be made to reduce operating costs and it is profitable from that standpoint alone. Safety to the public requires that highway improvement be such that congestion will be relieved and accidents reduced. Finally, until improvement in highways approaches in some measure the increase in vehicles, it is evident that increased highway programs bring safety, economy, and comfort to the traveling public.

Federal Road Work Sets Record

FEDERAL-AID road work progressed more rapidly in the fiscal year ending June 30, 1931, than in any preceding year, says Thomas H. MacDonald, Chief of the Bureau of Public Roads in the annual report of the bureau submitted to the Secretary of Agriculture, and made public in Washington recently. During the year 11,033 miles were completed as compared with 8,682 miles the preceding year. The mileage completed is composed of 7,939 miles of road improved for the first time with Federal aid, 3,082 miles previously improved but now raised to a higher type, and 12 miles of reconstructed road. Actual payments to the states amounted to $133,340,000.

At the close of the fiscal year the projects under construction totaled 16,480 miles as compared with the 9,916 miles in progress at the end of the preceding year.

By three separate actions taken during and shortly before the beginning of the last fiscal year, Federal-aid road construction, normal during the previous eight years, was virtually doubled with a consequent increase in employment of labor. These actions were: In April, 1930, an increase from $75,000,000 to $125,000,000; in the authorization for the fiscal year the early apportionment—in September instead of December as usual—of the $125,000,000 authorized for the fiscal year 1932; and the appropriation in December, 1930, of $80,000,000 to be apportioned to the States and to be used by them in lieu of an equal amount of State money in matching regular Federal-aid funds. The Federal Government is to be reimbursed for the latter funds by deductions from regular Federal-aid apportionments over a 5-year period beginning July 1, 1932.

The increase in funds and their earlier availability enabled the States to put through the largest Federal-aid construction program on record.

The mileage of road under construction at the end of February, 1931, was greater than at the end of May, 1930, and by the end of March work was under way on a mileage of road practically equal to that under construction in July of 1930.

The average number of persons employed on all Fed-

eral and Federal-aid road construction, including the national-forest and park work, increased from 54,852 in March to 154,453 in June, a gain of 100,000 in three months.

The bureau estimates that for every person directly employed on the road work proper two others are employed on the average in the manufacture and transportation of road materials and equipment. On this basis the total employment furnished by the Federal and Federal-aid road program in June, 1931, was probably equivalent to full-time work for more than 460,000 persons.

On June 30, 88,713 miles of road had been completed with Federal aid during the entire period of Federal-aid operation. This mileage was composed of the following types: Graded and drained, 11,248 miles; treated and untreated sand-clay, 7,274 miles; treated and untreated gravel, 29,256 miles; treated and untreated macadam, 2,345 miles; low-cost bituminous mix, 1,574 miles; bituminous macadam, 4,196 miles; bituminous concrete, 3,427 miles; Portland cement concrete, 28,010 miles; block, 993 miles; and bridges and approaches totaling 390 miles.

Within the fiscal year improvements were completed on 281 miles of the National Forest road system, bringing the total mileage improved to date with Federal funds to 4,638 miles. Of the mileage improved during the year 254 miles were in the Western States and Alaska. Of the total mileage improved to date 4,281 miles are in the West and 357 in the East.

By agreement with the National Park Service the bureau has supervised the construction of 68 miles of National Park road, bringing the total of such roads completed to 370 miles. The system of major park roads to be completed includes 1,509 miles.

Other important activities carried on during the year included cooperation with the State Department in holding the Sixth International Road Congress in Washington in October, 1930; completion of the field work involved in a traffic survey in 11 Western States; a traffic survey in Michigan and a study of taxation in Wisconsin; highway production costs studies; and various physical researches relating to the best methods of road construction.

The future is the most interesting tense of industrial security values, yet financial statements reveal only the past and present.

An aid to judging future values is an element which does not appear in the balance sheet—it is called, "the fixed attitude toward research."

It may be interesting to know that some of the keener bankers investigate the research attitude before underwriting industrial securities; particularly when they intend to retain some of them.—*The Laboratory*, Vol. 4, No. 5.

U. S. Road Funds Seen as Work Stabilizer

"FEDERAL funds for road building is one of the greatest stabilizing factors in the current business period," W. C. Markham, executive secretary of American Association of State Highway Officials, declared recently.

Attention was called by Mr. Markham to the employment of over 350,000 men in building roads on the state highway systems, in 1931, remarking that "although Federal Aid embraces only about one-tenth of the money actually spent in state road betterment the effect of this Federal assistance was to stimulate the states to much greater activity than if little or no Federal Aid had been granted."

"The need for improved highways in the United States is so acute that everyone should be in favor of the method that will bring the most roads," said Mr. Markham. "To those who have studied road building it is quite apparent that there is no better way than through Federal government guidance as pronounced through Federal Aid. Federal Aid, therefore, is doubly valuable at a time like this when men need work.

"It is indeed fortunate that Federal monies will be extended on a fairly large scale during coming years. Thousands and thousands of the men employed in road work this year would have been out of jobs if these funds had been curtailed. The 350,000 road men at work in 1931 represented, considering their families, some 1,500,000 individuals. Federal participation was responsible for the well being of at least a third of these people.

"On the other hand it would be distinctly unfortunate if Federal cooperation were to be reduced in any degree, for the history of state road building shows that not only has Federal Aid led the states to think in progressive terms but also to throw more energy and devote more money to road building than they would otherwise have done. Business conditions are such that public construction as a bulwark against unemployment is vividly revealed. To reduce Federal funds would be to aid materially to the nation's jobless.

"It would be a different matter if the need for smooth travelways were not so great. But as it is, the cost and inconvenience of motoring must be reduced. Money properly spent on road improvement, as is every nickel that comes under the supervision of the Federal government, saves as much or more for motorists. Further, bargain prices in construction work now prevail. Today's dollar is buying more roads.

"All things considered, particularly from the standpoint of providing work for large numbers of men, the Federal government participation assumes a magnificent importance and the country can be thankful that this plan is in operation," concluded Mr. Markham.

Gasoline Consumption Not Affected by Depression

IN THE face of the customary increase in motor vehicle registration each year, the consumption of gasoline shows a marked increase in the first half of 1931 as compared with the first half of 1930, according to W. R. Smith, president of the American Road Builders' Association.

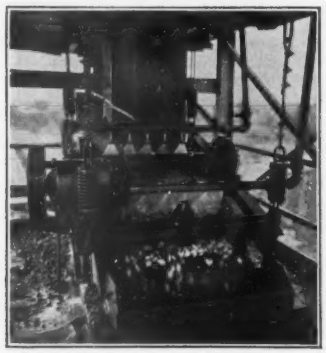
"Statistics of gasoline consumption give a total of 7,118,000,000 gallons for the first half of 1931 in contrast with 6,810,000,000 gallons for the first half of 1930, an increase of 2.3 per cent," stated Mr. Smith. "These figures were compiled by the U. S. Bureau of Public Roads based on a careful survey.

"In Minnesota the increased return from gasoline consumption was 8.7 per cent on gasoline taxes collected from January 1 to October 31, 1931, according to figures compiled by the Minnesota Highway Department. During the same period the tax collected on motor vehicles decreased one-half of one per cent in Minnesota. Many other states show a similar record.

"It appears evident from these figures that travel by motor vehicle has increased in spite of the depression, whether for recreational or business use. Traffic counts in Minnesota indicate that more motor vehicles are using the highways this year than ever before.

"Due to the fact that many people have put off buying new automobiles, it seems evident that there will be a rapid increase in motor vehicle registration when business conditions return to normal," continued Mr. Smith.

Complete Washing Equipment *for* Producing Clean Aggregate



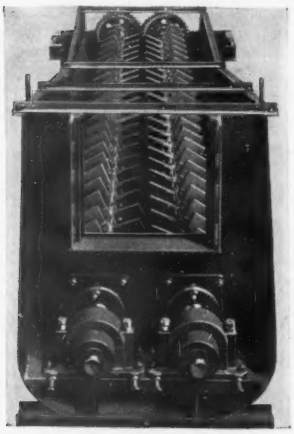
Vibrating Screen with Sprays for Washing.

THE demand for clean washed aggregates is increasing rapidly and concrete specifications are becoming so stringent that this phase of the producing problem has become vitally important.

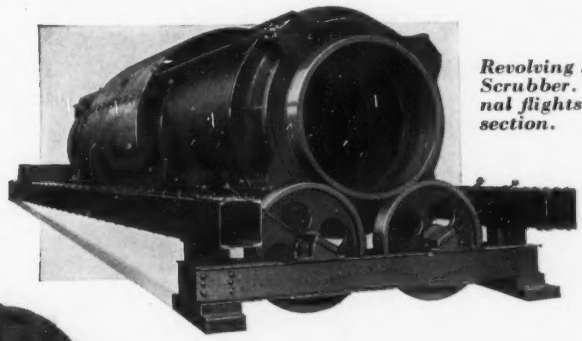
Because some materials are easy to wash whereas others are difficult, depending upon the nature of the deposit, the selection of proper combinations of machinery to meet these varying conditions necessitates a complete line of washing equipment.

Allis-Chalmers has supplied machinery for many washing plants, having a wide range of machinery to meet every condition and engineers with experience in applying this machinery.

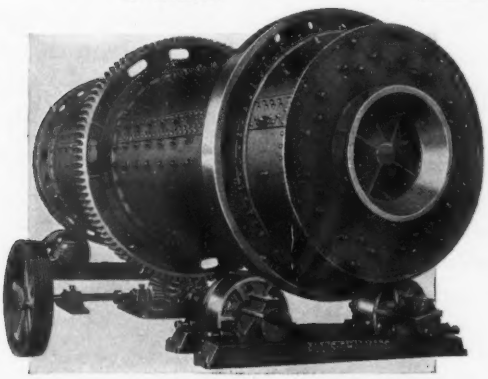
A new booklet has been prepared on this important subject. Write for Bulletin 1471.



Log Washer for Stone or Gravel.

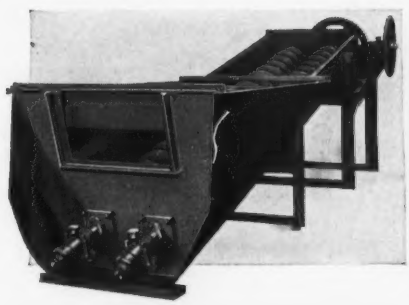


Revolving Screen Type Scrubber. Note internal flights in washing section.



Left - Stone Scrubber.

Right - Double Screw Sand Washer.



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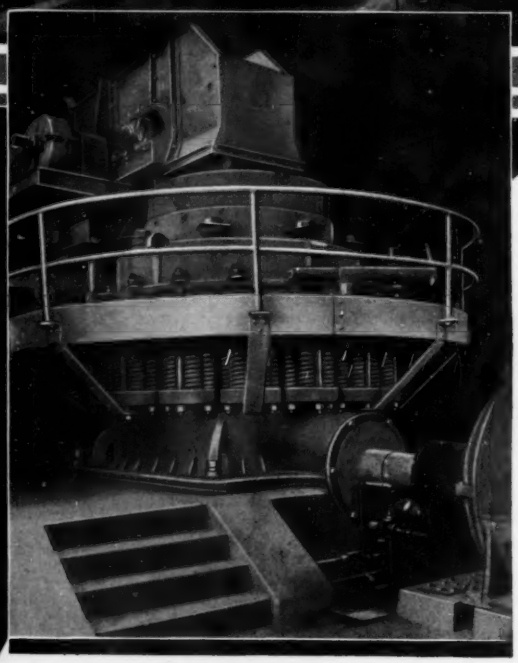
Allis-Chalmers Manufacturing Company, Milwaukee

AMERICA'S OUTSTANDING ROCK CRUSHING PLANT USES SYMONS CONE CRUSHERS



One of two 7 foot Symons Cone Crushers, which do all the secondary crushing at the Clinton Point Plant. At the Haverstraw Plant, two 4 foot Symons Cones are also in service.

MODERN to the last detail. This new crushing plant of the New York Trap Rock Company at Clinton Point, New York, is outstanding not only because of its capacity, but because of the many new ideas that have been incorporated into its design and construction.

For this, like most modern crushing plants built in recent years, Symons Cone Crushers were selected for the secondary crushing. That Symons Cones should consistently be chosen by those of wide experience and in a position to appreciate their merits, is ample proof of why they lead in the reduction crushing field today.

There is no need to take chances with your reduction crushing operations. Built in five sizes ranging from 2 to 7 foot diameters, there is a Symons Cone that will meet your requirements for capacity, give you a better product and reduce your crushing costs.

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National Crushed Stone Association
Fifteenth Annual Convention

JANUARY 19, 20, 21 and 22, 1932
Hotel William Penn
Pittsburgh, Pa.

● Railroads Authorize Reduced Fares

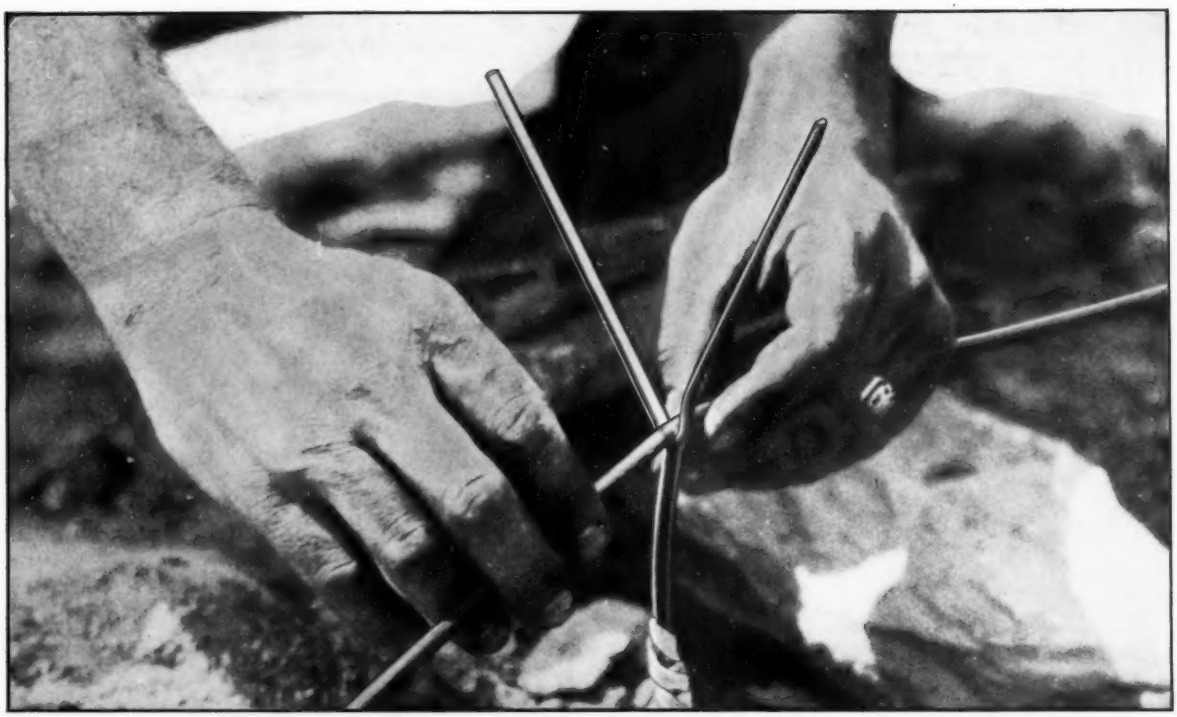
1. Reduced fare to Pittsburgh has been authorized under the Round Trip Identification Certificate Plan.
2. Upon presentation of certificate to ticket agent, delegate is entitled to purchase a round trip ticket to Pittsburgh for fare and one-half times the regular one-way fare.
3. Certificates WILL NOT be available at offices of ticket agents, and can only be procured from the Secretary's Office in Washington.
4. Certificates are being mailed to all contemplating attendance at the Convention.

●

● Have You Received Your Certificate?

If not, you should IMMEDIATELY communicate with J. R. Boyd, Secretary, National Crushed Stone Association, 1735 14th Street, N. W., Washington, D. C., requesting that one be sent to you.

5. Please help us to pass this information along as it would be regrettable if some of those attending the Convention were denied the privilege of obtaining reduced fare to Pittsburgh because they had failed to obtain a certificate.



Here too Safety is the Sign of Skill

It means safety if all holes are detonated completely. Cordeau-Bickford, the instantaneous detonating fuse, provides the means for this; and it will not fail when hooked up properly. Be sure to seat the main line *firmly* in the crotch of the slit of each branch line before making the wrap connection. For correct layout follow the diagrams in our Cordeau-Bickford booklet.

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